Organization(s): Tanner Research

Title: Next Generation MEMS Design Tools

Duration of Effort: September 1996 - September 1999

MTO **Composite CAD**

Principal Investigator(s): Barry Dyne
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Objective

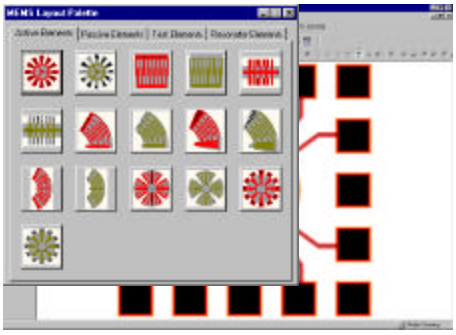
The goal of this project is to lower the barriers to the use of MEMS technology through the creation of an integrated suite of CAD tools for mixed technology design, with both device and system level tools. Device design tools include solid modeling, self-consistent finite and boundary element analysis, and behavioral model extraction. System design tools include mixed technology schematic, simulation, place and route, extraction and design rule checking. A library of components contains a schematic, simulation, and layout representation of each device, and device layout may be synthesized from functional or geometric parameters.

Progress/Results

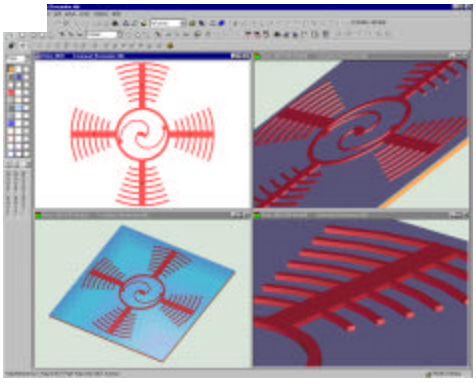
- Developed fabrication process definition standard for Composite CAD.
- Completed integrated 3D modeling, visualization and layout editing. A common database with synchronization checking ensures the 3D model is kept up-to-date with the layout.
- Completed automatic mesh generation for MEMS. The approach takes advantage of MEMS aspect ratios, providing 10x improvement over general purpose automatic meshers.
- Completed a link between 3D modeling and ANSYS finite element analysis.
- Model Builder support for generation of SPICE models. Demonstrated Design Of Experiments with University of Michigan partner Selden Crary.
- Completed Schematic support for mixed technology. MEMS and IC devices can be placed in schematic, with electrical and mechanical signals.
- New simulation elements for MEMS devices, Matlab models supported in simulation engine.
- Completion of mixed technology block place and route. MEMS and IC components can be placed and routed, with online signal integrity analysis.
- Mixed technology DRC supported, including multiple rule sets and context sensitive rules.
- Mixed technology Extract supported.
- Library of components developed, consisting of schematic symbol, simulation model, and layout generation. Optimization module generates layout from functional description.
- Foundry support, including MCNC MUMPS, MCNC LIGA, ADI iMEMS,
- Commercial release of MEMS Pro V2, including 3D modeling, mixed technology block place and route, mixed technology schematic, optimization module, libraries, and technology support.

Status

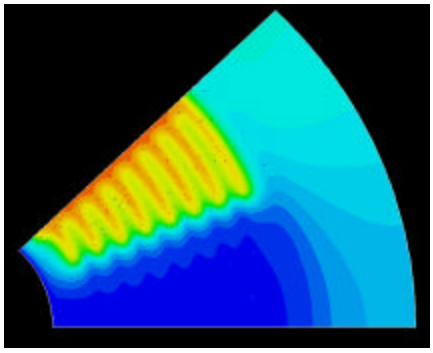
- Contract on schedule to completion in September 1999.
- Technology developed through contract funding released in MEMS-Pro V2, additional core technology under transition to commercial product in future release.



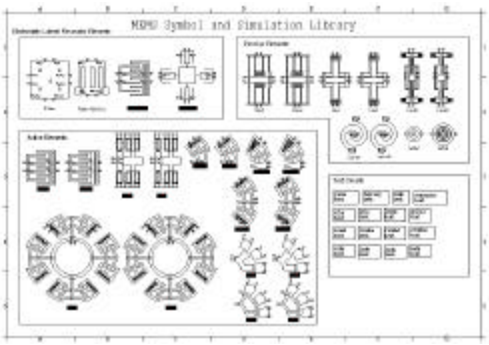
i) Layout Generation



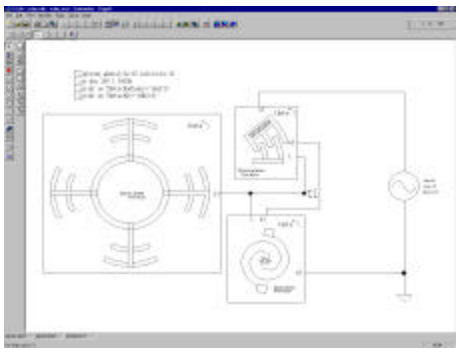
ii) 3D Modeling



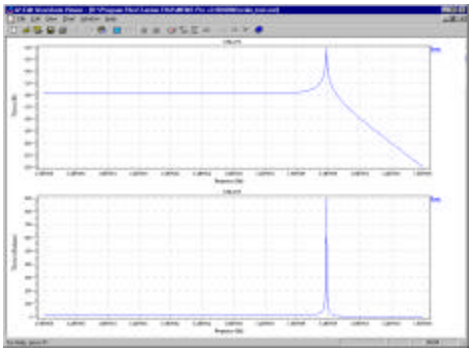
iii) Finite Element Analysis



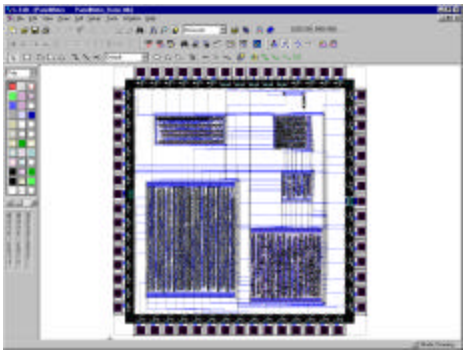
iv) Library of Components



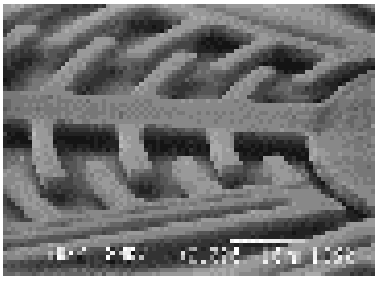
V) Mixed Technology Schematic



vi) Mixed Technology Simulation



vii) Block Place and Route



viii) Output to Fabrication

Illustration of the Tanner Research MEMS-Pro design, i) Parameterized macro layout generation, ii) Integrated 3D Modeling with layout synchronization, iii) 3D multiphysics finite element analysis, iv) Device placed into component library, v) MEMS and IC components instanced into mixed domain schematic with multidomain signals, vi) Mixed technology simulation integrated with schematic, vii) Mixed technology place and route tools with online signal integrity, viii) Output design to fabrication.